

Title: Quilts, “A FUNdraising Experience”

Brief Overview:

The class has decided to hold an auction to raise funds for the school. The students will be creating a class quilt for the auction. They will explore concepts of area, measurement and patterns found within parallelograms and triangles. The culminating activity will require students to create their own unique quilt designs.

Links to NCTM 2000 Standards:

- **Standard 1: Number and Operation**

Mathematics instructional programs should foster the development of number and operation sense so that all students understand numbers, ways of representing numbers, relationships among numbers, and number systems; and understand the meaning of operations and how they relate to each other

- **Standard 2: Patterns, Functions, and Algebra**

Mathematics instructional programs should include attention to patterns, functions, symbols, and models so that all students understand various types of patterns and functional relationships; and use symbolic forms to represent and analyze mathematical situations and structures

- **Standard 3: Geometry and Spatial Sense**

Mathematics instructional programs should include attention to geometry and spatial sense so that all students analyze characteristics and properties of two- and three-dimensional geometric objects; and use visualization and spatial reasoning to solve problems both within and outside of mathematics.

- **Standard 4: Measurement**

Mathematics instructional programs should include attention to measurement so that all students understand attributes, units, and systems of measurement; and apply a variety of techniques, tools, and formulas for determining measurements.

- **Standard 6: Problem Solving**

Mathematics instructional programs should focus on solving problems as part of understanding mathematics so that all students build new mathematical knowledge through their work with problems; develop a disposition to formulate, represent, abstract, and generalize in situations within and outside mathematics; apply a wide variety of strategies to solve problems and adapt the strategies to new situations; and monitor and reflect on their mathematical thinking in solving problems.

- **Standard 7: Reasoning and Proof**

Mathematics instructional programs should focus on learning to reason and construct proofs as part of understanding mathematics so that all students recognize reasoning and proof as essential and powerful parts of mathematics; make and investigate mathematical conjectures; develop and evaluate mathematical arguments and proofs; and select and use various types of reasoning and methods of proof as appropriate.

- **Standard 8: Communication**

Mathematics instructional programs should use communication to foster an understanding of mathematics so that all students organize and consolidate their mathematical thinking to communicate with others; express mathematical ideas coherently and clearly to peers, teachers, and others; extend their mathematical knowledge by considering the thinking and strategies of others; and use the language of mathematics as a precise means of mathematical expression.

- **Standard 9: Connections**

Mathematics instructional programs should emphasize connections to foster an understanding of mathematics so that all students recognize and use connections among different mathematical ideas; understand how mathematical ideas build on one another to produce a coherent whole; and recognize, use, and learn about mathematics in contexts outside of mathematics.

- **Standard 10: Representation**

Mathematics instructional programs should emphasize mathematical representations to foster an understanding of mathematics so that all students create and use representations to organize, record, and communicate mathematical ideas; develop a repertoire of mathematical representations that can be used purposefully, flexibly, and appropriately; and use representations to model and interpret physical, social, and mathematical phenomena.

Grade/Level:

Grades 4 - 6

Duration/Length:

Four to five one hour class periods

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Basic operations (+, -, \times , \div)
- Geometric shapes
- Measuring with a metric ruler

Student Outcomes:

Students will:

- identify polygons.
- make conjectures and formulate rules.
- identify and construct complex patterns.
- use problem-solving strategies.
- compute area.

Materials/Resources/Printed Materials:

- Metric rulers
- Colored construction paper or white paper with crayons
- Student Activity Sheets (1 - 4C)

- Scissors
- Glue (if crayons are not used)
- Calculators (optional)
- Pattern blocks (optional)
- Protractors (optional)

Development/Procedures:

Lesson 1 - Exploring Area of Polygons

- Distribute Lesson 1 student activity sheets (Activities 1A to 1F).
- Have students work individually or cooperatively on self-guided activities to find the area of different polygons (parallelograms and triangles), make conjectures on finding the area of these polygons, and explore the relationship among these formulas.
- Assess students' understanding of these concepts by conducting a class discussion where student insights, formulas, and relationships are shared.

Lesson 2 - Discovering Patterns

- Distribute Lesson 2 student activity sheets (Activities 2A to 2B).
- Distribute a ruler or straight edge.
- Have students work individually or cooperatively on self-guided activities to investigate how changing the dimensions of a polygon changes its area.
- Have students complete a function table, look for patterns, and formulate a rule for the function table.

Lesson 3 - Measuring Area of Polygons

- Distribute Lesson 3 activity sheets (Activities 3A to 3C).
- Distribute a metric ruler.
- Have students work individually or cooperatively on self-guided activities to measure the area of various polygons. Using their measurements, have students problem solve to determine which geometric design will meet the qualifications of the given task.
- Group students to share their findings and recommendations.

Performance Assessment:

- As a culminating activity, students are given a scenario (Student Activity Sheets 4A - 4C) in which they will create their own patch for a quilt using a variety of polygons and specified quilt dimensions. Students will demonstrate their understanding of the mathematical concepts explored through the use of pictures, diagrams, and a written response. Finally, students will be required to write a letter including information about valuable new insights that they have discovered, such as formulas, patterns, relationships among polygons, etc. A rubric is provided from which to evaluate the final product.
- This performance assessment is tiered into three levels in order to meet the needs of individual students. The tiers may be assigned to students, or students may select an appropriate level of tier.

Extension/Follow Up:

- Incorporate cost computation by varying price of material of different colors. Which patterns are class favorites? Which are most cost effective?

- Have students further explore and create area formulas and concepts for other geometric shapes.
- Explore the area of student-created geometric designs as the dimensions are increased or decreased proportionally and non-proportionally.

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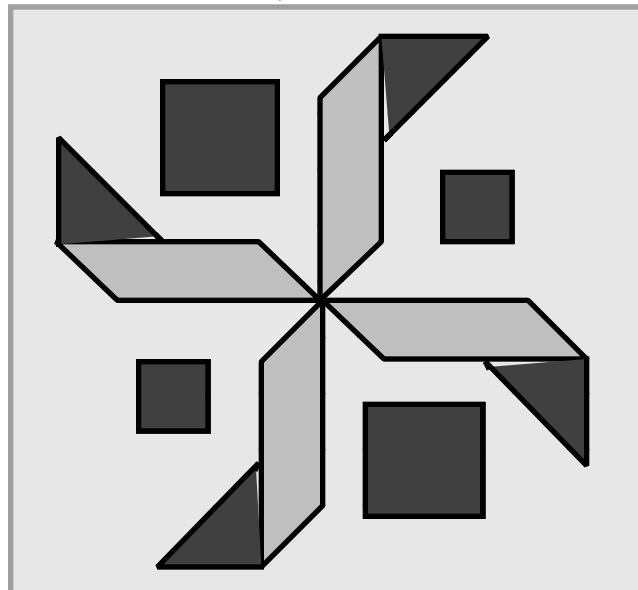
Name _____

Quilts

"A FUNdraising Experience"

In order to raise the much-needed money for instructional supplies, your school is gearing up for its annual silent auction. The Parent Teacher Association (PTA) has asked each class to create and donate items for this special fund-raising event. After much discussion, your class unanimously decides to create a series of quilts in a variety of sizes. The class feels that parents and students alike would cherish these student-generated keepsakes, and the variation in quilt sizes would serve a multitude of purposes. This would, in return, create a high demand for these items.


Before beginning your series of quilts, many considerations must be taken into account such as patterns and area. Being careful planners, your group decides it must first investigate several mathematical concepts before designing the final quilts. Your teacher agrees to provide several exploratory lessons that will aid you in this endeavor.



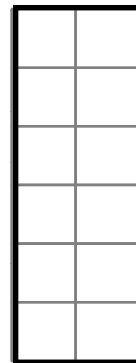
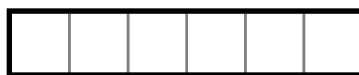
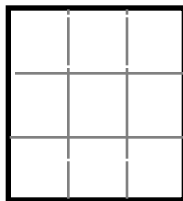
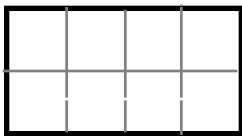
LESSON 1 - Exploring Area of Polygons

Before creating your quilt design, you need to explore the area of several different types of polygons. This will help you when creating your design in the limited work space of your quilt patch.

- 1A. Complete the charts below each rectangle with the appropriate data. (B = Base, H = Height, A = Area)

Example: H  B

B	H	A
5 un	2 un	10 un ²



B	H	A

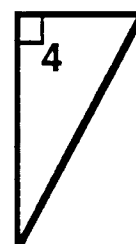
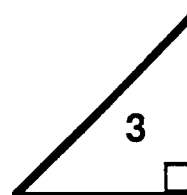
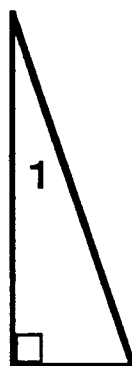
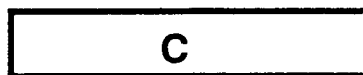
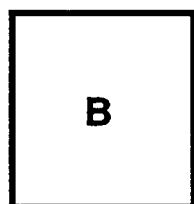
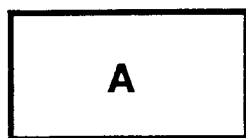
B	H	A

B	H	A

B	H	A

Construct a formula or rule for finding the area of any rectangle (a parallelogram with four right angles).

1B.

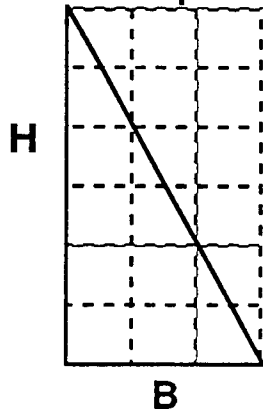
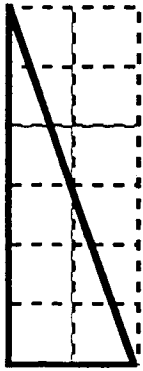


If you walked into a fabric store needing the above triangular pieces, which rectangular-shaped material would you use? Draw a line from the triangular piece to the corresponding rectangular piece of material.

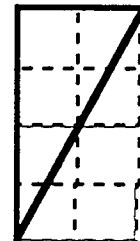
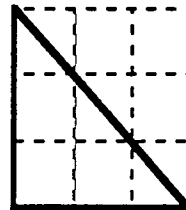
Select one of your matches to explain how and why they correspond to each other.

1C. Complete the charts below each right triangle with the appropriate data. (B = Base, H = Height, A = Area)

Example:



B	H	A
3 un	6 un	9 un ²



B	H	A

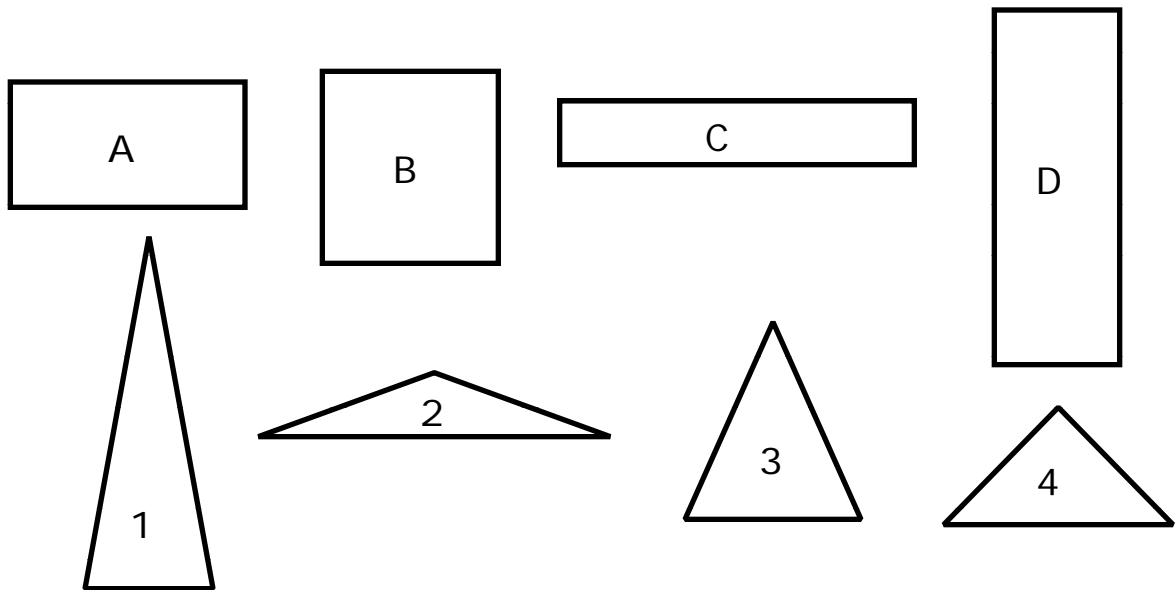
B	H	A

B	H	A

B	H	A

Construct a formula or rule for finding the area of any right triangle (a triangle with at least one right angle - remember, a right angle is one that measures 90°).

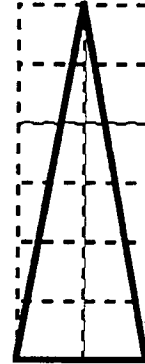
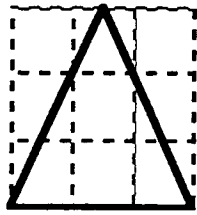
1D.



If you walked into a fabric store needing the above triangular pieces, which rectangular-shaped material would you use? Draw a line from the triangular piece to the corresponding rectangular piece of material.

Select one of your matches to explain how and why they correspond to each other.

1E. Complete the charts below each isosceles triangle with appropriate data. (B = Base, H = Height, A = Area)



B	H	A

B	H	A

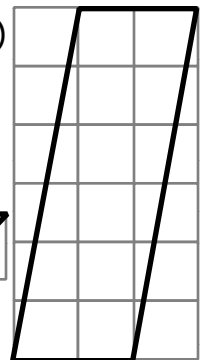
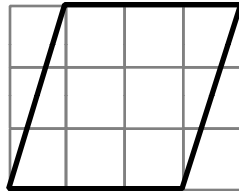
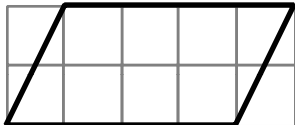
B	H	A

B	H	A

Construct a formula for finding the area of any isosceles triangle (a triangle with two congruent or equal sides).

How does this formula compare with the formula for a right triangle?

1F. Complete the charts below each parallelogram with appropriate data. (B = Base, H = Height, A = Area)



B	H	A

B	H	A

B	H	A

B	H	A

Construct a formula for finding the area of any non-rectangular parallelogram (a quadrilateral containing congruent opposite angles and sides, but is not a rectangle).

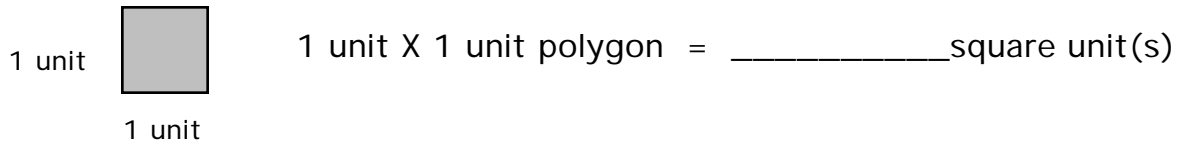
Review Task 1A where you explored the area of various rectangles. How does the area of rectangles compare with the area of non-rectangular parallelograms? Explain.

Name_____

LESSON 2 - Discovering Patterns

Now that you have an understanding of finding area, you will investigate how changing the dimensions affects the area of that polygon.

2A. Given the following polygon, calculate its area.



Predict what would happen to the area if the base and height of the polygon were both doubled in size.

Draw and label this (2 unit X 2 unit) polygon to prove or disprove your prediction. Explain your findings.

What would happen to the area if the dimensions of the original polygon were tripled (3 units X 3 units)? Explain your reasoning. You may include an illustration.

2B. Do you see any patterns in how the area of a figure increases as the dimensions increase? Set up a function table to demonstrate this pattern.

Base of Polygon	Area of Polygon
1 unit	1 square unit
2 units	
...	...
10 units	
X units	

What patterns do you see in your function table? Show these in the space below.

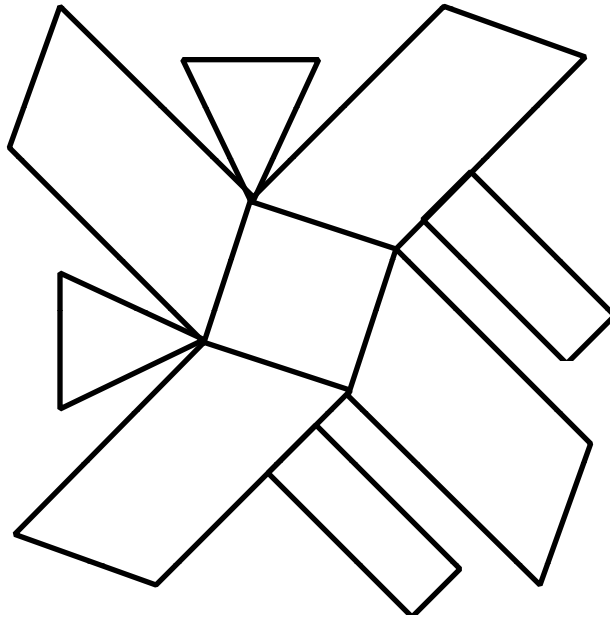
Explain the rule of your function table.

Name _____

LESSON 3 - Measuring Area of Polygons

- 3A. A classmate has created two designs to fit within his 10cm X 10cm patch. He plans to submit one of these designs for the auction quilt. Use a ruler to help him measure the area of each figure he has created. When measuring round each dimension (base/height) to the nearest centimeter.

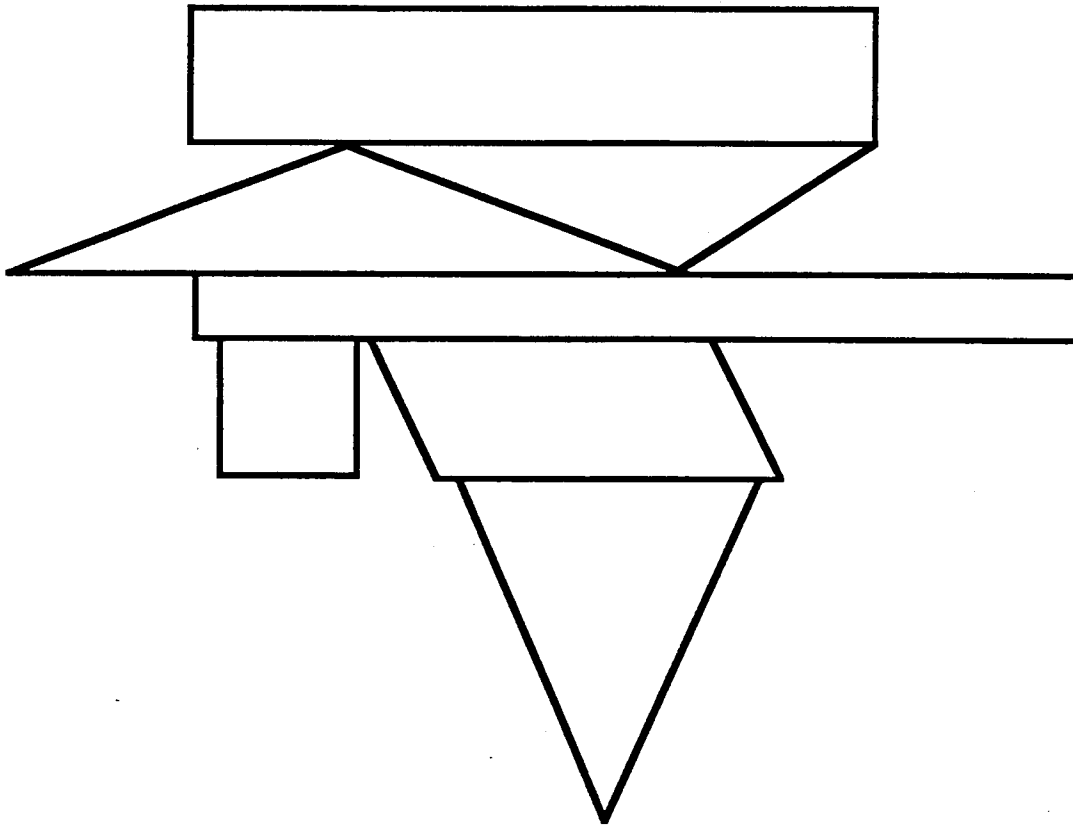
Design #1



Show work below.

Total area of all polygons in Design #1 = _____

Design #2



Show work below.

Total area of all polygons in Design #2 = _____

3B. Which design should your classmate submit? Justify your answer.

3C. Why is it important to know the dimensions and area of your quilt design? Explain.

Quilts

“A FUNdraising Experience”

Performance Assessment

Using different polygons and a 10cm X 10cm patch, create a unique quilt design. Your polygons may be replicated and used several times in your figure. Place your final creation on your 10cm X 10cm patch.

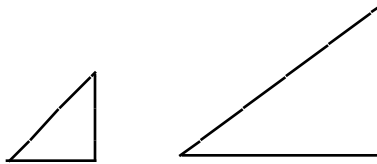
Next, determine the area of each polygon and the total area of your figure. Demonstrate how one could determine the area of your quilt design by using pictures, diagrams, and/or a written explanation. Finally, write a letter to your classmates explaining your design. Your letter should include information about valuable new insights that you have discovered, such as formulas, patterns, relationships between polygons, etc.

Tier 1

- Use two or more different types of polygons (triangle, regular parallelogram, etc...)

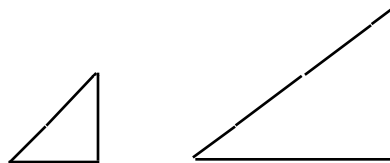
Tier 2

- Use three or more different types of polygons (right triangle, regular parallelogram, other parallelogram...)
- Vary the size of polygons that are used



Tier 3

- Use three or more different types of polygons
- Vary the size of polygons that are used

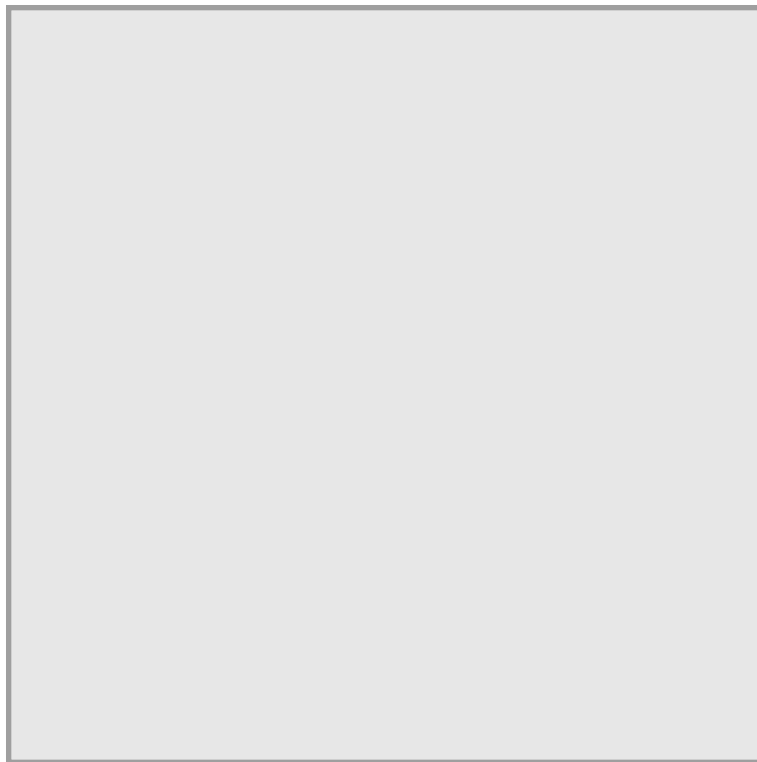


- Include at least one polygon that has not yet been explored (pentagon, hexagon, trapezoid, etc...)
- Determine the formula for finding the area of that/those “new polygon(s)”

Name_____

Quilts
“ A FUNdraising Experience”

Plan your quilt design on the 10 cm X 10 cm patch below.



Measurements:

Quilts

"A FUNdraising Experience"

Rubric for Performance Assessment

This response demonstrates the ability to identify polygons, compute the area of a polygon, and communicate mathematically.

3

- ☐ All parts of the tiered assignment are complete.
- ☐ The required amount of polygon figures and sizes are used.
- ☐ Design fits inside a 10cm X 10cm patch.
- ☐ Area is correctly computed for each polygon and the total figure.
- ☐ Written explanation demonstrates a thorough understanding of finding the area of polygons.

2

- ☐ All parts of the tiered assignment are complete.
- ☐ The required amount of polygon figures are used.
- ☐ Area computed for each polygon is mostly correct with only a few minor errors.
- ☐ Written explanation demonstrates a fair understanding of finding the area of polygons.

1

- ☐ All parts of the tiered assignment are complete.
- ☐ At least half of the required amount of polygon figures are used.
- ☐ Major errors may occur in the computation of area.
- ☐ Written explanation demonstrates an unsatisfactory understanding of finding the area of polygons.

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NSR (Non-Scorable Response)